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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Marlene Dortch, Esq.
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: ET Docket No. 98-153
Ex Parte **Submission of**
Siemens VDO Automotive AG

Dear Ms. Dortch

Pursuant to Section 1.1206(b) of the Commission's rules, Siemens VDO Automotive AG ("Siemens VDO") submits this *ex parte* letter in the above referenced proceeding to address the discrete issue of why the Commission should permit the root mean square ("RMS") average power of Siemens VDO's pulsed frequency hopping ("FH") vehicular radar device to be measured with the frequency hop active [1] Siemens VDO has consistently and repeatedly stated that the measurement of average power must be taken with the hop active in order to enable an accurate measurement [2] and to prevent a severe competitive disadvantage to

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1/ *See* Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, ET Docket 98-153, *First Report and Order*, FCC 02-48 (rel. April 22, 2002) ("*UWB R&O*") at ¶ 32 (analogizing to the requirement in Section 15.31(c) regarding the measurement of swept frequency devices and concluding that "Similarly, measurements on a stepped frequency or frequency hopping modulated system are performed with the stepping sequence or frequency hop stopped "). *See also* Filing and Measurement Guidelines for Frequency Hopping Systems, *Public Notice*, DA 00-75, (rel Mar 30, 2000) ("unless otherwise specified, the hopping function must be disabled for the following tests") ("*Guidelines*")

2/ *See, e.g.,* Siemens VDO Petition for Reconsideration (June 17, 2002) at 7 and Annex at 14, Siemens VDO Request for Waiver (Sept 9, 2002) at 7, 10, Siemens VDO Comments

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the Siemens VDO pulsed FH device in comparison to pure impulse vehicular radars. 3/

Requiring the RMS average power measurement to be taken with the frequency hop stopped results in distorted average power readings that are referenced only to a small portion of the bandwidth that is occupied by the Siemens VDO device in normal operation mode. By definition, the RMS average power has to be taken over a given bandwidth and time interval. If either the bandwidth or the time interval is changed, the RMS average value will change accordingly. With the FH stopped, the instantaneous bandwidth is only a fraction of the full bandwidth of operation. Consequently, the average power will have to be reduced by 10 log DC_{hop}, 4/ making the FH power spreading method ineffective. 5/

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to the *Further Notice* (July 21, 2003) at 25-27, Siemens VDO Reply Comments to the *Further Notice* (Aug 20, 2003) at 7

3/ *See, e g ,* Siemens VDO Petition for Reconsideration (June 17, 2002) at 2, 4; Reply to Oppositions (Aug 13, 2002) at 5; Siemens VDO Reply Comments to the *Further Notice* (Aug 20, 2003) at 5

4/ DC_{hop} is defined as the frequency hopping duty cycle and expresses the ratio of the instantaneous bandwidth to the full occupied bandwidth, including the hopping

5/ Siemens VDO explained this in greater detail on pages 25-26 in its Comments to the *Further Notice*:

> With the frequency hopping stopped, the average power (RMS) measurement would only show a single line power spectrum where the sinc-envelope is determined by the pulse width, and the individual single power-lines are separated by the PRF value This spectrum is typical for a pure pulsed device. One important manner in which the Siemens VDO pulsed FH and the pure pulsed devices differ relates to the pulse width. Pure pulsed devices have a pulse width between 0.1 to 2 ns, whereas the Siemens VDO pulsed FH SRRs have typical pulse widths of 50 ns. Measured in a 1 MHz RBW, the difference in the PDCF is therefore approximately 28 dB (*i.e.,* the peak power over entire BW of the Siemens VDO pulsed FH SRRs must be lower by about 28 dB compared to pure pulsed devices with a 2 ns pulse width and the same PRF in order to achieve similar SLP levels)
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> Furthermore, if the RMS power were measured with the frequency hopping stopped, the additional power spreading due to the frequency hopping would not be captured by the RMS measurements Because the occupied bandwidth that results from frequency hopping, B_{FH}, is much greater than the instantaneous occupied bandwidth resulting from pure pulse spreading, B_{pulse}, the RMS measurement over the entire frequency hopping bandwidth B_{FH} would either result in: (1) no RMS reading at all, if not measured within the instantaneous

Requiring that the hopping be stopped would also limit significantly the PRF that Siemens VDO will be able to employ. With the FH stopped, the Siemens VDO device turns into a pure impulse UWB device. In this case, the dividing line between being peak or average power limited occurs at a pulse repetition frequency ("PRF") of 187 kHz. Consequently, above 187 kHz PRF, the stopped FH device would be artificially average power limited. The only way to operate with a PRF higher than 187 kHz would be to reduce the total carrier power EIRP (*e.g* , a 1 MHz PRF would result in an unjustified peak power reduction of 7 28 dB, compared to the operation with a PRF of 187 kHz or below). Given that both detection performance and the false alarm rate are dependent on the average power measured over the entire FH bandwidth, pure impulse vehicular radars would have a 10 log DC_{hop} performance advantage over the Siemens VDO pulsed FH device if the RMS average power of the Siemens VDO device could not be measured with the hopping active. With such a lower detection performance, the Siemens VDO device would not be competitive vis a vis pure impulse vehicular radar devices, and Siemens VDO would not be able to market such a device successfully.

There is no sound policy reason for requiring the RMS average power of the Siemens VDO device to be measured with the hopping stopped. Significantly, NTIA explicitly determined, after detailed testing of the Siemens VDO device prototype, that "the radiated emissions from a pulsed FH radar prototype can be accurately measured while it is operating in a frequency hopping mode."6/ Moreover, in its January 15, 2004 comments in this docket, NTIA submitted proposed certification measurement procedures for pulsed FH vehicular radar systems, in which it recommended that RMS average power measurements be

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occupied bandwidth B_{pulse} or (2) a RMS reading that reflects the instantaneous, pure pulse related average power. Such average power would, depending on the PRF applied, be either a line spectrum or a PSD, both shaped by a sinc envelop function that is controlled by the pulse width. As noted above, the factor B_{FH} / B_{pulse} produces an additional, frequency hopping-related "duty cycle" that reduces the real PRF by the ratio (B_{FH} / B_{pulse}) within the spectrum analyzer's RBW. With a B_{FH} of 1 GHz and a 50 ns pulse width (*i.e.,* B_{pulse} = 20 MHz), the additional, frequency hopping related duty cycle would be 50 (*i.e.,* 17 dB), reducing a real PRF of 1 MHz to a fictive 20 kHz PRF within the 1 MHz RMS RBW

6/ NTIA, "Measurements of Siemens Pulsed Frequency Hopping Vehicular Radar Prototype," Mar 20, 2003 at 37 taken with the device operating in frequency hopping mode.[7] The Commission should follow NTIA's recommendation on this point. In addition, the Commission, in coordination with NTIA, granted Siemens VDO a waiver of the Commission's Part 15 rules with respect to its pulsed FH vehicular radar in June 2003. In the waiver grant, the Commission expressly authorized the RMS average power of the Siemens VDO device to be measured with the hopping active. [8]

As OET Chief Ed Thomas was recently quoted regarding the Motorola/Multiband OFDM Alliance debate relating to the UWB rules:

> The religion isn't whether it hops or not, it's whether or not it interferes. If the NTIA and the FCC agrees that this does not cause any problems, we haven't violated our religion, and there's only one commonsense conclusion to draw The Holy Grail is to make sure that whatever's deployed in UWB does not cause harm. [9]

Given Mr. Thomas's proper emphasis on interference potential, rather than on modulation details, it is worth noting again that the Siemens VDO device will present no greater likelihood than pure impulse devices of causing harmful interference to any victim receiver, whether terrestrial or space borne. EESS will not be at any greater risk, due to the spatial integration that takes place. The aggregated power at the EESS receiver from multiple vehicular radars is averaged over the EESS antenna's footprint on the earth's surface. This spatial integration results in a smoothing of the individual pulses, and makes the identification of a single device or modulation type practically impossible. In its Comments, NTIA agreed that "the interference impact to EESS sensor receivers from pulsed frequency hopping vehicular radars is comparable to that of the impulse vehicular radars permitted by the Commission's UWB rules." [10]

Nor will the Siemens VDO device pose any greater threat of harmful interference to terrestrial services. Siemens VDO convened a group of technical experts in Milan, Italy in June 2002 to conduct a compatibility study with regard to

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[7] Comments of the National Telecommunications and Information Administration (Jan 15, 2004) ("*NTIA Comments*") at D-5

[8] *See* letter from Edmond J Thomas, FCC, to Ari Q Fitzgerald, Hogan & Hartson L L P. (June 25, 2003) at 2.

[9] "NTIA to Referee Wideband Interference Debate," *EE Times* (Jan. 29, 2004)

[10] *NTIA Comments* at 16

the fixed services. [11] The study, which considered the Siemens VDO device as well as a number of impulse and BPSK vehicular radars, demonstrated that vehicular radar devices can share the 24 GHz band with fixed service links on a non-harmful interference basis The analysis confirmed that the Siemens VDO vehicular radar, which has a high peak to average ratio (RMS average power was measured with frequency hopping active), is peak-power limited, while devices with a low Crest Factor (like the BPSK or a CW carrier) are average-power limited.

Previously, the Short Range Automotive Radar Frequency Allocation Group ("SARA") commissioned an independent third-party study of vehicular radar compatibility with police radar. The study, which specifically considered the Siemens VDO pulsed FH modulation type, concluded that, assuming "real road conditions," it is "quite unlikely that UWB-[vehicular radar] equipped cars will interfere with" police radars. [12] Likewise, with regard to the amateur services, no harmful interference is expected, as there will be a strong decoupling of the antennas of amateur stations and the Siemens VDO vehicular radar devices due to the highly directional nature of each. [13] Not surprisingly, therefore, the record in this proceeding contains no comments expressing concern that the operation of the pulsed FH vehicular radars will adversely affect any terrestrial service. Accordingly, the Commission has no reason to be concerned that the Siemens VDO device will cause harmful interference to EESS or to other terrestrial operations.

If there remains any doubt regarding the recommendation that RMS average power measurements of pulsed FH vehicular radars be conducted with the hopping active, the Commission should consider that its rules – by imposing independent peak and average limits – provide something of a "cross check" mechanism. Under the rules, the Siemens VDO device, like other high peak-to-average, low PRF devices, is inherently peak-power limited. [14] As the Commission recognized in the *UWB R&O*

11/ The study was submitted to the ITU-R Sector *See* "Compatibility Analysis of 24 GHz Vehicular Short Range Radar Devices and Fixed Service Links in the 24 GHz Range," Document 1-8/30-E (Oct 22, 2003)

12/ *See* Interference Study (SRR – RSM) of Cetecom ICT Services, Inc (May 22, 2003) at 2

13/ For additional explanation on this point, *see* Siemens VDO Comments to the Further Notice at 14

14/ *See* Siemens VDO Comments at 8, 11-12, Siemens VDO Reply Comments at Annex.

> We do not agree with Lucent that a minimum VBW of 10 kHz needs to be established or that a "correction factor" needs to be applied to average emission measurements of short burst transmissions. Lucent has not provided any information to demonstrate why the application of a 10 kHz VBW, representing an averaging period of 100 milliseconds, to a burst UWB transmission would result in a higher interference potential. We agree that burst transmissions would have a low average measurement because of their short period of operation. However, the peak levels we are establishing would limit such transmissions. A UWB system with a high peak-to-average ratio would be peak-limited, resulting in the measured average emission level being well below our limits. [15]/

Given that FH devices create "short bursts" within a victim receiver's narrower bandwidth, the Commission's own reasoning above illustrates that such devices are automatically peak limited, with average measurements "well below [applicable average power] limits." Moreover, RMS average power measurements performed with the hopping stopped would produce readings that are referenced to a bandwidth that is too small, or to a PRF that is too high, to achieve an accurate measurement.[16]/ The RMS average power, when measured with hopping stopped would end up being misleadingly higher than the actual power generated as a result of the normal operation of the Siemens VDO device. A rule that requires that the RMS average power of the Siemens VDO device be measured with the hopping stopped would thus restrain unnecessarily its operation.

If the hopping is disabled, the Siemens VDO device will not be able to achieve the normal FH spreading which reduces the power density of the signal at any frequency over the transmitted bandwidth and thereby reduces the probability

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15/ *UWB R&O* at ¶ 243

16/ From the transmitter perspective, the occupied bandwidth will vary depending on whether the frequency hopping is stopped (i.e., will correspond to the device's instantaneous impulse spectrum bandwidth) or active (i.e., will correspond to the device's frequency hopping bandwidth). If the reference bandwidth used to determine the average power does not reflect the actual frequency hopping bandwidth, then the average power measured will be misleadingly high.

From the victim receiver (or spectrum analyzer) perspective, the PRF will vary depending on whether the frequency hopping is stopped (i.e., will correspond to the PRF of the device) or active (i.e., will correspond to the PRF of the device reduced by the DC_{hop} ratio). If the frequency hopping is stopped during the average power measurement, the spectrum analyzer either measures nothing (if the frequency hop doesn't fall within the spectrum analyzer's receiver bandwidth) or the power emitted in the spectrum analyzer's RBW with the full PRF of the device (if the frequency hop always falls within the spectrum analyzer's receiver bandwidth). In the first case the average power is zero, in the second case the average power is misleadingly high.

of causing interference to other signals occupying the band. [17] In other words, with the hopping stopped, the device appears to be more likely to cause interference than it actually would in normal operation.

The 1 ms averaging time imposed by the Commission for RMS average power measurements in the restricted bands provides an additional safeguard to ensure that measuring the Siemens VDO device with the hopping active will not raise interference concerns. With a 1 ms averaging time long quiescent periods are automatically prohibited. While the peak power limit controls burstlike operation, the RMS average limit with a 1 ms integration time controls the maximum average power EIRP in the victim receiver bandwidth. With such a sufficient safeguard, it is not necessary to specify that the RMS average power be measured with the hopping stopped.

In imposing the hopping stopped requirement in the *UWB R&O*, the Commission relied on its past practice of using such a measurement method for FH devices. [18] The circumstances underlying the measurement *Guidelines* specified in the past, however, are different from the circumstances underlying pulsed FH vehicular radar devices. Prior to the development of the UWB rules, FH devices needed only comply with a peak power limit. [19] For peak power measurements, the results are not affected by whether the hop is stopped or active. Having the hop stopped for taking the peak power measurement probably made the process more

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[17] As the Commission is already aware, frequency hopping spread spectrum systems "spread their energy by changing, or 'hopping,' the center frequency of the modulated signal This spreading reduces the power density of the signal at any frequency over the transmitted bandwidth, thereby reducing the probability of causing interference to other signals occupying the band." Commission Amends Part 15 of the Rules to Facilitate Technology for High Speed Wireless Services, *News*, ET Docket No 99-231 (Aug. 31, 2000).

[18] *See UWB R&O* at ¶ 32 This past practice was in the form of guidelines contained in a public notice, not a rule. *See Guidelines, supra* note 1. The public notice made it clear that the guidelines did not constitute the only possible measurement methods, but noted that "the following provides . information on the measurement techniques that have been accepted in the past for equipment authorization purposes " *Id* at 1 Moreover, it is important to note that the *Guidelines* called for the hop to be *enabled* for a few tests. Thus, had there been a test for RMS average power, the *Guidelines* could have specified an active hop without being inconsistent with the remainder of the document

[19] *See* 47 C F R § 15 247 Indeed, it was only recently that RMS average measurements became an established spectrum analyzer measurement procedure.

convenient,[20] which may have been one rationale for the directions delineated in the *Guidelines*.

The *UWB R&O* also relied, by analogy, on Section 15.31(c), which requires that measurements of swept frequency equipment are to be made "with the frequency sweep stopped at those frequencies chosen for the measurements to be reported." This rule does not apply specifically to frequency hopping devices and, again, is only relevant to peak power measurements. [21] The fact that disabling the hop changes the results for RMS average power measurements but not for peak power measurements is an important distinction that renders the pre-existing precedent irrelevant.

Finally, the Commission stated that the sweeping or hopping stopped rule was necessary because "no measurement procedures have been proposed or established," nor had the interference aspects of the devices "been evaluated based on the different measurement results that would be obtained from measurements taken with the sweep active." [22] As explained above, this is no longer a valid rationale after NTIA's testing and recommendations.

In new section 15.521(d), added by the *UWB R&O*, the Commission, noting that alternative procedures could be considered, required that if "pulse gating is employed where the transmitter is quiescent for intervals that are long compared to the nominal pulse repetition interval, measurements shall be made with the pulse train gated on." This rule has no relevance to pulsed FH devices such as the Siemens VDO device, but appears instead to have been intended for pure impulse systems. For pulsed FH systems the frequency hopping is part of the inherent spreading process, like the line power spreading that is caused by the pulse width of a pure impulse system. The hopping of a pulsed FH system should not be viewed as analogous to pulse gating because it occurs not in the time domain, but in the frequency domain. A transmitter that employs pulse gating prohibits all emissions for a period of time, regardless of frequency. By contrast, with frequency hopping, the transmitter is not quiescent for intervals that are long compared to the

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20/ With the hopping disabled, the spectrum analyzer will show a stable picture within a shorter period of time

21/ From a practical perspective, it is actually necessary to make a peak power measurement first with the hopping active to find the relevant frequencies where the maximum emission occurs By tuning the device to those particular frequencies, a measurement consistent with Section 15 31(c) can be then taken with the hopping stopped.

22/ *See UWB R&O* at ¶ 32

nominal pulse repetition interval, but instead is emitting with the nominal pulse repetition interval in frequency bands that change over time due to the hopping process. Thus, it would be inappropriate to view the frequency hopping period of a pulse FH device as a "quiescent period" within the meaning of section 15.521(d).

Even if the Commission were to decide that its past policy with regard to FH device measurements should generally be applied even to RMS average measurements, the Commission should nevertheless clarify that such measurements for pulsed FH vehicular radar devices operating in the 22-29 GHz band may be taken with the frequency hopping active. Unlike other devices under development that may seek to take advantage of the Commission's new Part 15 rules, the Siemens VDO vehicular radar has already undergone extensive testing by the OET and NTIA, and all concerns relating to potential interference to existing services in the band have been successfully addressed. Thus, there is no reason for the Commission to destroy the marketability of one technology when it has been well established that no harmful interference will occur.

Respectfully submitted,

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